CLAIMS

What is claimed is:

1. An optical density sensor for sensing toner on a surface in an image forming device, comprising:

an integrating cavity having a diffuse, reflective inner surface and having a view port formed therein;

an optical source disposed in a collimator and positioned to illuminate said surface through said view port, said collimator extending into said integrating cavity; and

an optical detector disposed within said integrating cavity outside of a direct optical path of said source.

2. The apparatus of claim 1 wherein said optical source is a light emitting diode.

3. The apparatus of claim 1 wherein said optical source emits infrared light.

4. The apparatus of claim 1 wherein said collimator is operative to focus light from said optical source through said view port and onto said surface, such that no light from said optical source directly strikes any interior surface of said integrating cavity.

5. The apparatus of claim 1 wherein said integrating cavity reflectometer further comprises a lens disposed in said collimator.

6. The apparatus of claim 1 wherein said optical detector is a photodiode.

7. The apparatus of claim 1 wherein said optical detector is a phototransistor.

8. The apparatus of claim 1 wherein said integrating cavity reflectometer further comprises a circuit card disposed proximate said optical source and detector.

9. The apparatus of claim 8 wherein said circuit card includes an optical detector sensing circuit.

10. The apparatus of claim 1 wherein said collimator is disposed within said integrating cavity at an angle from a direction normal to said surface in the range from about 5 degrees to about 30 degrees.

11. The apparatus of claim 10 wherein said collimator is disposed within said integrating cavity at an angle from a direction normal to said surface of about 15 degrees.

12. The apparatus of claim 1 wherein said integrating cavity includes a shroud covering at least part of said collimator, said shroud having a diffuse, reflective surface.

13. The apparatus of claim 1 wherein any portion of said collimator within said integrating cavity that is in the path of specular reflection from said surface, has a diffuse, reflective surface.

14. The apparatus of claim 1 wherein said integrating cavity further includes a compensating slot formed therein, said compensating slot operative to allow light

reflected from said surface to directly strike said optical detector when said view port is spaced apart from said surface.

15. The apparatus of claim 1 wherein said surface is an intermediate transfer belt operative to transfer a developed toner image from one or more photoconductive members to a media sheet.

16. The apparatus of claim 1 wherein said surface is a media sheet.

17. The apparatus of claim 1 wherein said surface is a media sheet transport belt.

18. An optical density sensor for sensing toner on a surface in an image forming device, comprising:

an integrating cavity having a diffuse, reflective inner surface and having a view port formed therein;

an optical source positioned to illuminate said surface through said view port;

an optical detector disposed within said integrating cavity outside of a direct optical path of said source; and

a circuit card disposed proximate said optical source and optical detector, said circuit card including at least one of an optical source drive circuit and an optical detector sensing circuit.

19. The apparatus of claim 18 wherein said optical source is disposed in a collimator.

20. The apparatus of claim 19 wherein said collimator extends within the interior of said integrating cavity.

21. The apparatus of claim 19 wherein said collimator includes a lens.

22. The apparatus of claim 19 wherein said collimator is operative to focus light from said optical source through said view port and onto said surface, such that no light from said optical source directly strikes any interior surface of said integrating cavity.

23. The apparatus of claim 18 wherein said surface is an intermediate transfer belt operative to transfer a developed toner image from one or more photoconductive members to a media sheet.

24. The apparatus of claim 18 wherein said surface is a media sheet.

25. The apparatus of claim 18 wherein said surface is a media sheet transport belt.

26. An optical density sensor for sensing toner on a surface in an image forming device, comprising:

an integrating cavity having a diffuse, reflective inner surface and having a view port formed therein;

an optical source positioned to illuminate said surface through said view port;

an optical detector disposed within said integrating cavity outside of a direct optical path of said source; and

a compensating slot formed in said integrating cavity and positioned to allow light reflected from said surface to directly strike said optical detector when said view port is spaced apart from said surface.

27. The apparatus of claim 26 wherein said optical source is disposed in a collimator.

28. The apparatus of claim 27 wherein said collimator extends within the interior of said integrating cavity.

29. The apparatus of claim 27 wherein said collimator includes a lens.

30. The apparatus of claim 27 wherein said collimator is operative to focus light from said optical source through said view port and onto said surface, such that no light from said optical source directly strikes any interior surface of said integrating cavity.

31. The apparatus of claim 26 wherein said further comprising a circuit card disposed proximate said optical source and detector.

32. The apparatus of claim 31 wherein said circuit card includes an optical detector sensing circuit.

33. The apparatus of claim 26 wherein said surface is an intermediate transfer belt operative to transfer a developed toner image from one or more photoconductive members to a media sheet.

34. The apparatus of claim 26 wherein said surface is a media sheet.

35. The apparatus of claim 26 wherein said surface is a media sheet transport belt.

36. An optical density sensor for sensing toner on a surface in an image forming device, comprising:

an integrating cavity having a diffuse, reflective inner surface and having a view port formed therein;

an optical source disposed in a collimator and positioned to illuminate said surface through said view port, said collimator extending into said integrating cavity;

an optical detector disposed within said integrating cavity outside of a direct optical path of said source;

a circuit card disposed proximate said optical source and optical detector, said circuit card including at least one of an optical source drive circuit and an optical detector sensing circuit; and

a compensating slot formed in said integrating cavity and positioned to allow light reflected from said surface to directly strike said optical detector when said view port is spaced apart from said surface.

37. The apparatus of claim 36 wherein said collimator includes a lens.

38. A method of sensing toner on a surface in an image forming device, comprising:

illuminating said surface with an optical source;

capturing light reflected from said source by said surface in an integrating cavity having diffuse, reflective inner surface, said reflected light passing through a view port formed in said cavity;

sensing light reflected from the inner surface of said cavity onto an optical detector disposed within said cavity outside of a direct optical path of said source; and

as said cavity moves apart from said surface, sensing light reflected from said source by said surface that directly strikes said optical detector, said light passing through a compensating slot formed in said cavity independent of said view port.

39. The method of claim 38 wherein the amount of light reflected by said surface directly striking said optical detector is directly proportional to the distance of said cavity from said slot.

40. The method of claim 38 wherein said light reflected from said source by said surface that directly strikes said detector compensates for the attenuation in light reflected from the inner surface of said cavity onto said optical detector due to the distance of said cavity from said surface.